APS M1P-SAA

Single-phase Micro-inverter

Installation and User Manual

Version: 4.0

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1. Important Safety Information

This manual contains important instructions to follow during installation and maintenance of the APS Photovoltaic Grid-connection Micro-inverter. To reduce the risk of electrical shock and ensure the safe installation and operation of the APS Micro-inverter, the following symbols appear throughout this document to indicate dangerous conditions and important safety instructions.

WARNING: This indicates a situation where failure to follow instructions may cause a serious hardware failure or personnel danger if not applied appropriately. Use extreme caution when performing this task.

NOTE: This indicates information that is important for optimized Micro-inverter operation. Follow these instructions closely.

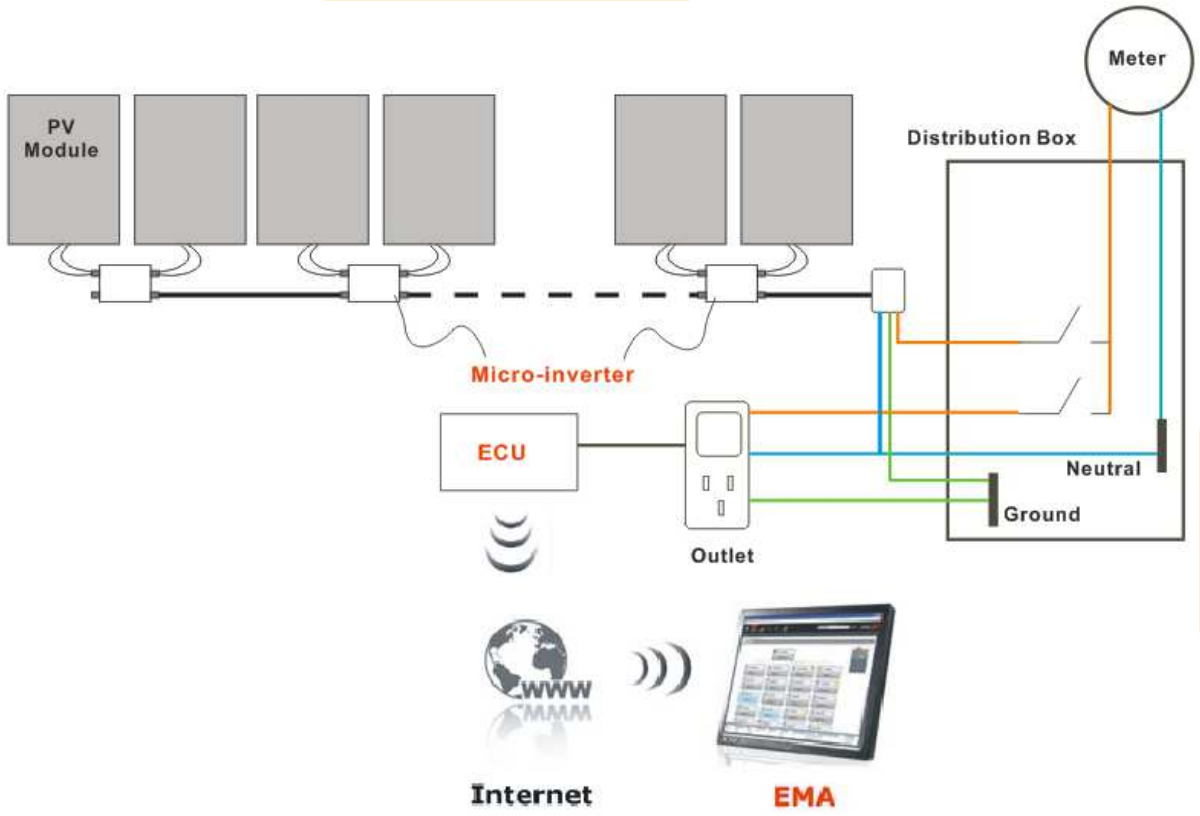
Safety Instructions

- Only qualified professionals should install and/or replace APS Micro-inverters.
- Perform all electrical installations in accordance with local electrical codes.
- Before installing or using the APS Micro-inverter, please read all instructions and cautionary markings in the technical documents and on the APS Micro-inverter system and the PV-array.
- Be aware that the body of the APS Micro-inverter is the heat sink and can reach a temperature of 80°C. To reduce risk of burns, do not touch the body of the Micro-inverter.
- Do NOT disconnect the PV module from the APS Micro-inverter without first disconnecting the AC power.
- Do NOT attempt to repair the APS Micro-inverter. If it fails, contact APS Customer Support to obtain an RMA number and start the replacement process. Damaging or opening the APS Micro-inverter will void the warranty.

2. APS Micro-inverter System Introduction

The APS Micro-inverter is an inverter system for use in utility-interactive applications, comprised of three key elements:

- Altenergy Power Systems Micro-inverter
- Altenergy Power Systems Energy Communication Unit (ECU)
- Altenergy Power Systems Energy Monitor and Analysis (EMA) web-based monitoring and analysis system



This integrated system improves safety; maximizes solar energy harvest; increases system reliability; simplifies photovoltaic (PV) system design, installation, maintenance, and management.

The APS Micro-inverters maximize energy production from photovoltaic (PV) arrays. Each PV module has individual Maximum Peak Power Tracking (MPPT) controls, which ensures that the maximum power is exported to the utility grid regardless of the performance of the other PV modules in the array. When PV modules in the array are affected by shading, soiling, orientation, or mismatch, the APS Micro-inverter ensures top performance from the array by maximizing the performance of each module within the array.

The APS Micro-inverter system is more reliable than centralized or string inverters. The distributed Micro-inverter system ensures that no single point of system failure exists across the PV system. APS Micro-inverters are designed to operate at full power at ambient

temperatures of up to 65°C. The inverter housing is designed for outdoor installation and complies with the IP65 environmental enclosure rating.

PV systems using APS Micro-inverters are very simple to install. You can install individual PV modules in any combination of module quantity, orientation, type, and power rate. ***The Ground wire (PE) of the AC cable is connected to the chassis inside of the Micro-inverter, eliminating the installation of grounding wire.***

The APS Micro-inverter system provides smart system performance monitoring and analysis.

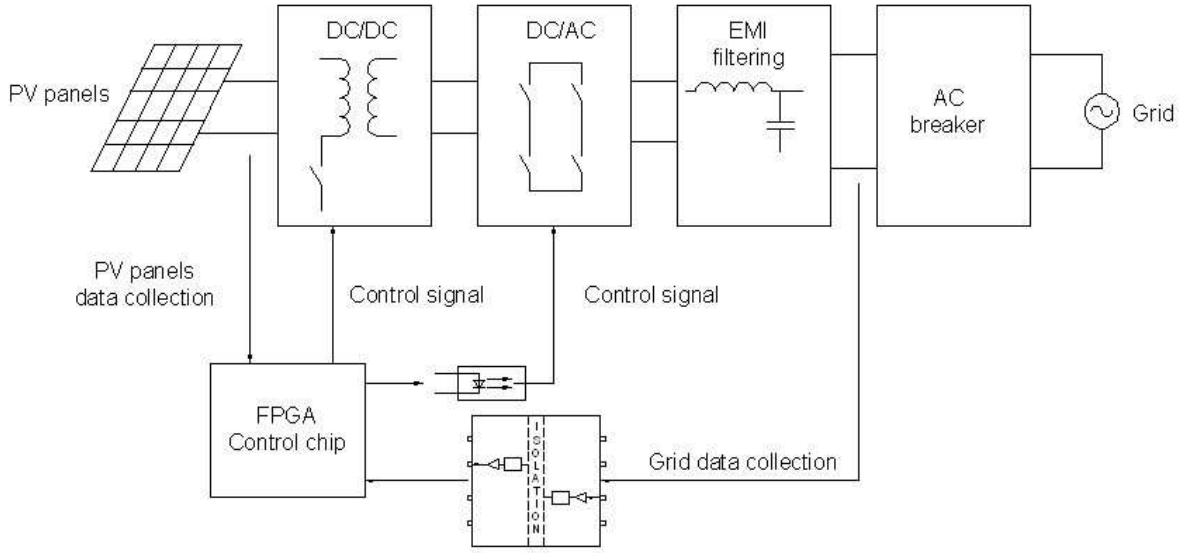
The APS Energy Communication Unit (ECU) is installed by simply plugging it into any wall outlet and providing an Ethernet or Wi-Fi connection to a broadband router or modem. After installing the ECU, the full network of APS Micro-inverters automatically reports to the APS Energy Monitor and Analysis (EMA) web server. The EMA software displays performance trends, informs you of abnormal events, and controls system shutdown when it is needed.

3. APS Single-phase Micro-inverter M1P series

The APS M1P series Micro-inverters connect with the single-phase grid, and operate with most 60,72 cell PV modules. For more information, please see the section 8 Technical Date of this manual.

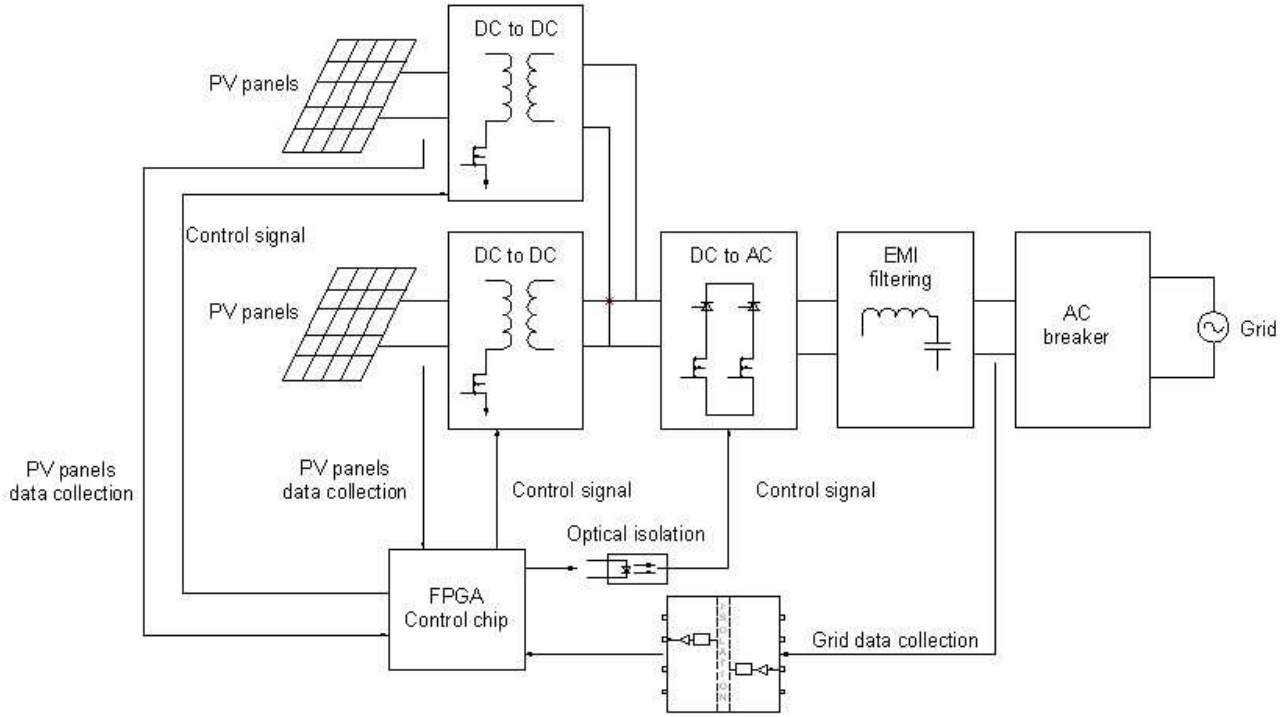
Model Number	AC grid	PV Module	Max. # Per branch	Module Connector
YC250A	50Hz/230V	60,72 Cell	14 for 20A breaker	MC-4 Type or Customize
YC250I	50Hz/230V	60,72 Cell	14 for 20A breaker	MC-4 Type or Customize
YC500A	50Hz/230V	60,72 Cell	7 for 20A breaker	MC-4 Type or Customize
YC500I	50Hz/230V	60,72 Cell	7 for 20A breaker	MC-4 Type or Customize
YC250A	50Hz/230V	60,72 Cell	18 for 25A breaker	MC-4 Type or Customize
YC250I	50Hz/230V	60,72 Cell	18 for 25A breaker	MC-4 Type or Customize
YC500A	50Hz/230V	60,72 Cell	9 for 25A breaker	MC-4 Type or Customize
YC500I	50Hz/230V	60,72 Cell	9 for 25A breaker	MC-4 Type or Customize

The following figure shows the APS YC250 micro-inverter schematic:



APS YC500 has two independent DC inputs, with independent MPPT control and data monitoring.

The following figure shows the APS YC500 micro-inverter schematic:



4. APS Micro-inverter System Installation

A PV system using APS Micro-inverters is simple to install. Each Micro-inverter easily mounts on the PV racking, directly beneath each PV module. Low voltage DC wires connect from the PV module directly to the Micro-inverter, eliminating the risk of high DC voltage.
Installation shall comply with local regulations and technical rules. Installation shall comply with the relevant instructions of AS 4777.1 /.2& AS 3000.

WARNING: Perform all electrical installations in accordance with local electrical codes.

WARNING: Be aware that only qualified professionals should install and/or replace APS Micro-inverters.

WARNING: Before installing or using an APS Micro-inverter, please read all instructions and warnings in the technical documents and on the APS Micro-inverter system itself as well as on the PV array.

WARNING: Be aware that installation of this equipment includes the risk of electric shock.

WARNING: Do not touch any live parts in the system, including the PV array, when the system has been connected to the electrical grid.

WARNING: Affix warning labels to micro system components where and as appropriate for your state/territory.

Additional Installation Components from APS

- Protective branch end cap (sold separately, 1 per branch)
- AC branch end cable (sold separately, 1 per branch)

Required Parts and Tools from you

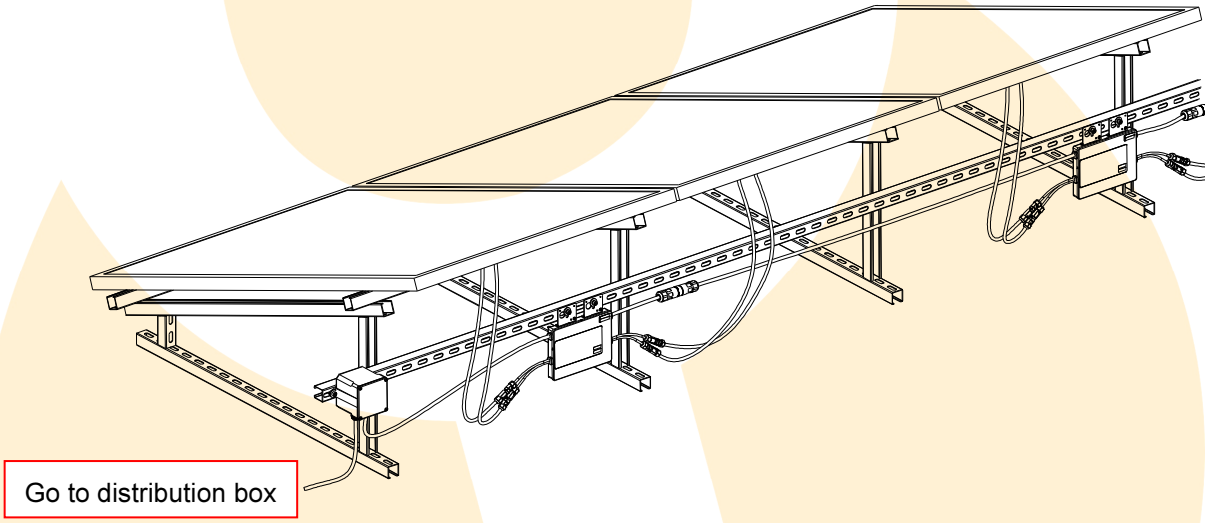
In addition to your PV array and its associated hardware, you need to provide the following:

- An AC isolator
- Mounting hardware suitable for module racking
- Sockets and wrenches for mounting hardware
- A Phillips screwdriver
- A torque wrench

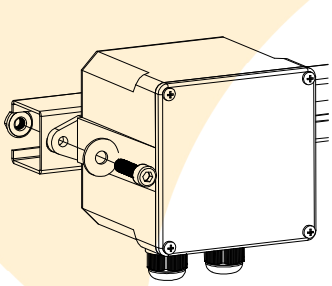
Installation Procedures

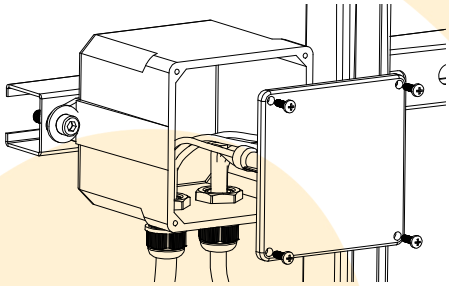
WARNING: Do NOT connect APS Micro-inverters to the utility grid or energize the AC circuit until you have completed all of the installation procedures as described in the following sections.

For bracket installation, after the completion of system installation rendering as follows:



Step 1 - Installing the AC Branch Circuit AC Isolator





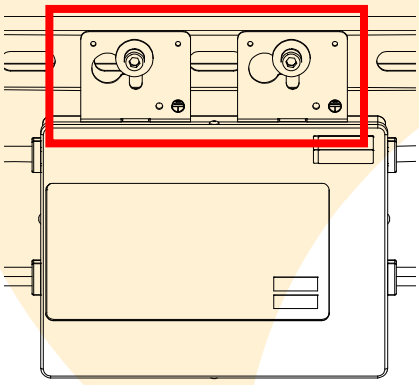
a. Install an appropriate AC isolator at a suitable location on the PV racking system (typically at the end of a branch of modules).
b. Connect the open wire end of the AC branch end cable into the AC isolator using an appropriate gland or strain relief fitting.
c. Wire the conductors: L- RED; N - BLACK; PE – YELLOW GREEN.
d. Connect the AC branch circuit AC isolator to the point of utility interconnection.

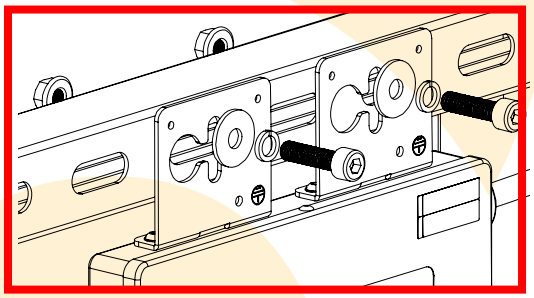
NOTE: Be sure to size the AC wire to account for voltage drop between the AC branch circuit AC isolator and the point of utility interconnection. Refer to the tables below.

	YC500 number in a branch						
	3	4	5	6	7	8	9
External Wire size (mm2)	*Maximum External cable length (m)*						
4	*113.3*	*81.0*	*60.8*	*46.7*	*36.0*	*27.5*	*20.4*
6	*151.1*	*108.0*	*81.1*	*62.2*	*48.0*	*36.7*	*27.3*
8	*206.1*	*147.3*	*110.5*	*84.8*	*65.5*	*50.0*	*37.2*
10	*266.7*	*190.6*	*143.1*	*109.8*	*84.7*	*64.7*	*48.1*

	YC250 number in a branch						
	6	8	10	12	14	16	18
External Wire size (mm2)	*Maximum External cable length (m)*						
4	*112.7*	*80.4*	*60.1*	*45.9*	*35.1*	*26.4*	*19.2*
6	*150.2*	*107.2*	*80.2*	*61.2*	*46.8*	*35.3*	*25.6*
8	*204.8*	*146.1*	*109.3*	*83.4*	*63.8*	*48.1*	*34.9*
10	*265.1*	*189.1*	*141.5*	*108.0*	*82.6*	*62.2*	*45.2*

Step 2 – Attaching the APS Micro-inverters to the Racking or the PV Module Frame



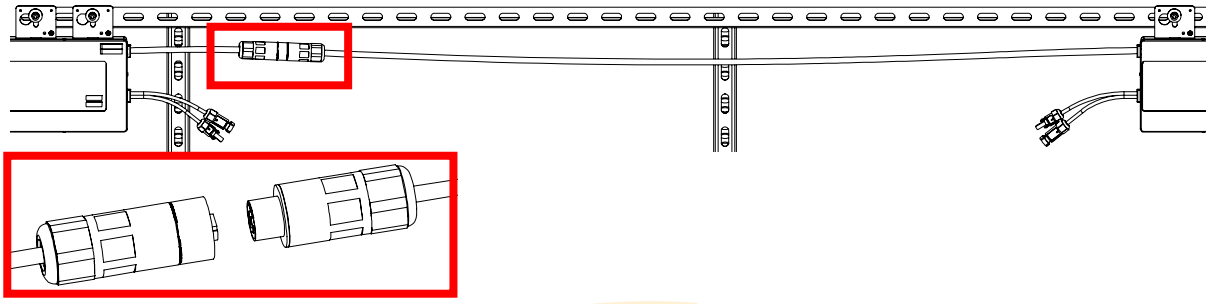


a. Mark the location of the Micro-inverter on the rack, with respect to the PV module AC isolator or any other obstructions.
b. Mount one Micro-inverter at each of these locations using hardware recommended by your module racking vendor.

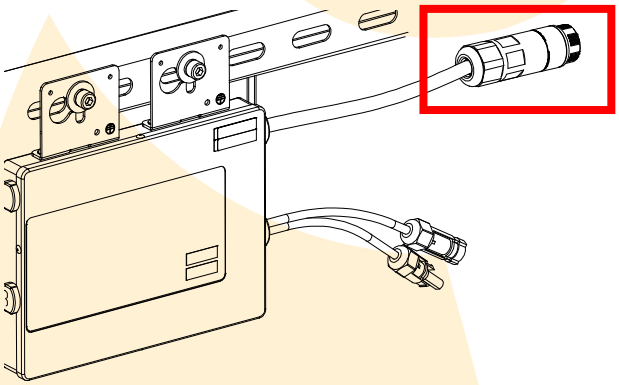
WARNING: Prior to installing any of the micro-inverters, verify that the utility voltage at the point of common connection matches the voltage rating on micro-inverter label.

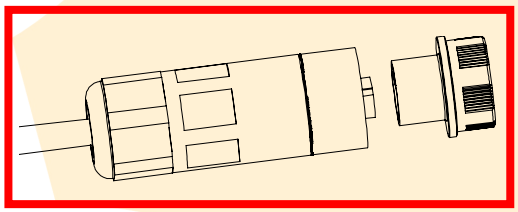
WARNING: Do not mount the Micro-inverter in a location that allows exposure to direct sunlight. Allow a minimum of 1.5 centimeters between the top of the roof and the bottom of the Micro-inverter.

Step 3 - Connecting the APS Micro-inverter AC Cables



a. Check the Micro-inverter rating label for the maximum allowable number of Micro-inverters on one AC branch circuit.
b. Plug the AC female connector of the first Micro-inverter into the male connector of the next Micro-inverter, and so on, to form a continuous AC branch circuit.
c. Install a protective branch end cap on the open AC connector of the last Micro-inverter in the AC branch circuit.

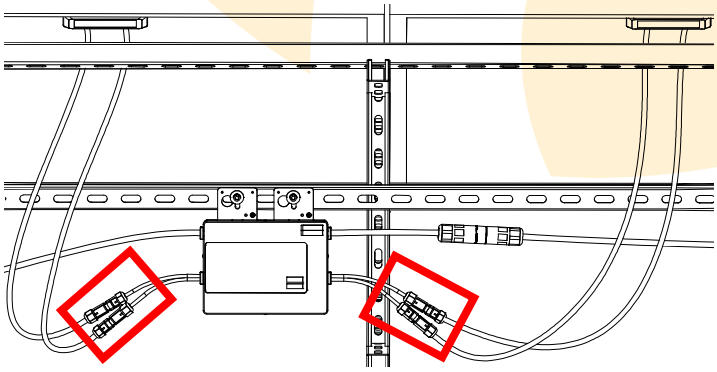


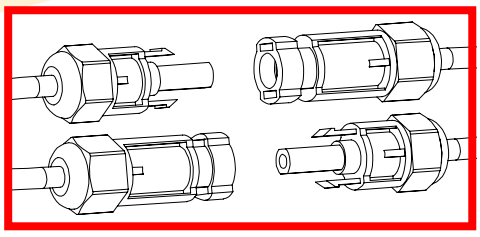


WARNING: Do NOT exceed the maximum number of Micro-inverters in an AC branch circuit, as displayed on the unit label.

Step 4 –Connecting APS Micro-inverters to the PV Module

Photovoltaic panels and micro-inverter DC input cable connection according to demand.





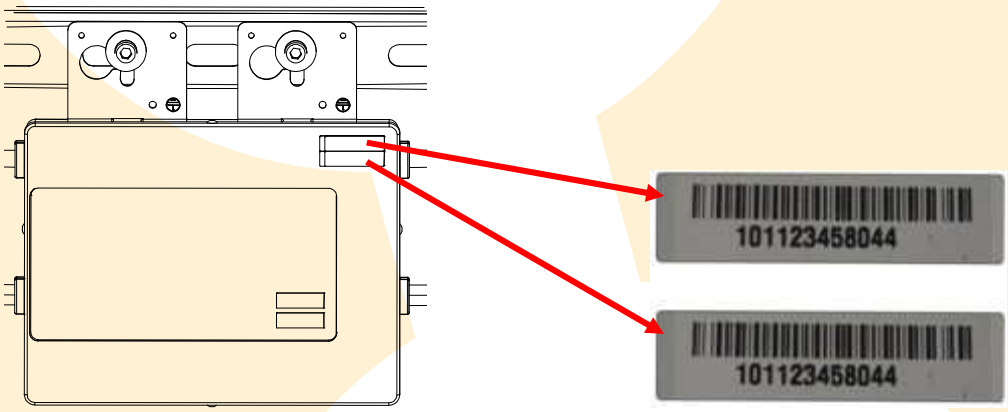
WARNING: Ensure that all AC and DC wiring is correct. Ensure that none of the AC and DC wires are pinched or damaged. Ensure that all AC isolator are properly closed.

NOTE: Step 1~4 can change sequence for convenience of installation.

Step 5 - Completing the APS Installation Map

You need to fill-in APS Warranty Cards, which provide system information and installation map. Feel free to provide your own layout if a larger or more intricate installation map is required.

a. Each APS Micro-inverter has removable serial number labels. Peel a label off, and affix it to the respective location on the APS installation map.
b. Fill the warranty cards and email to APS at emasupport@altenergy-power.com.
c. APS will setup the EMA account and email you information, and then you can use the EMA website to view detailed performance of your PV system.



5. APS micro-inverter system operating instructions

To operate the APS micro-inverter PV system:

1. Turn ON the AC circuit breaker on each micro-inverter AC branch circuit.
2. Turn ON the main utility-grid AC circuit breaker. Your system will start producing power after a two-minute waiting time.

Note: Once DC power is applied, the Status LED of each micro-inverter will blink green three times to indicate normal start-up operation.

3. The APS micro-inverters will start to send performance data over power line to the ECU. The time required for all the micro-inverters in the system to report to the ECU will vary with the number of micro-inverters in the system. You can verify proper operation of the APS micro-inverters via the ECU. See the *ECU Installation and Operation Manual* for more information.

6. Troubleshooting

Qualified personnel can use the following troubleshooting steps if the PV system does not operate correctly.

Status Indications and Error Reporting

Startup LED

When DC power is first applied to the micro-inverter:

- Three short green blinks when DC power is first applied to the micro-inverter indicate a successful micro-inverter startup

Operation LED

Flashing Slow Green (10s gap) - Producing power and communicating with ECU
Flashing Fast Green (2s gap) – Producing power and not communicating with ECU
Flashing Red – Not producing power

Other Faults

All other faults are reported to the ECU. Refer to the *ECU Installation and Operation Manual* for a list of additional faults and troubleshooting procedures.

WARNING: Be aware that only qualified personnel should troubleshoot the APS micro-inverter.

WARNING: Never disconnect the DC wire connectors under load. Ensure that no current is flowing in the DC wires prior to disconnecting. An opaque covering may be used to cover the module prior to disconnecting the module.

WARNING: Always disconnect AC power before disconnecting the PV module wires from the APS micro-inverter. The AC connector of the first micro-inverter in a branch circuit is suitable as a disconnecting means once the AC branch circuit breaker in the load center has been opened.

WARNING: The APS micro-inverter is powered by PV module DC power. Make sure you disconnect and reconnect the DC connections to watch for the three short LED flashes.

Troubleshooting a non-operating APS micro-inverter

To troubleshoot a non-operating APS micro-inverter, follow the steps below in order:

1. Verify the utility voltage and frequency are within ranges shown in the in section 8 Technical Data of this manual.
2. Check the connection to the utility grid. Verify utility power is present at the inverter in question by removing AC, then DC power. **Never disconnect the DC wires while**

the micro-inverter is producing power. Re-connect the DC module connectors and watch for three short LED flashes.

3. Check the AC branch circuit interconnection between all the micro-inverters. Verify each inverter is energized by the utility grid as described in the previous step.
4. Make sure that any AC breaker are functioning properly and are closed.
5. Check the DC connections between the micro-inverter and the PV module.
6. Verify the PV module DC voltage is within the allowable range shown in the Section 8 Technical Data of this manual.
7. If the problem persists, please call APS Energy customer support.

WARNING: Do not attempt to repair the APS micro-inverter. If troubleshooting methods fail, please return the micro-inverter to your distributor for replacement.

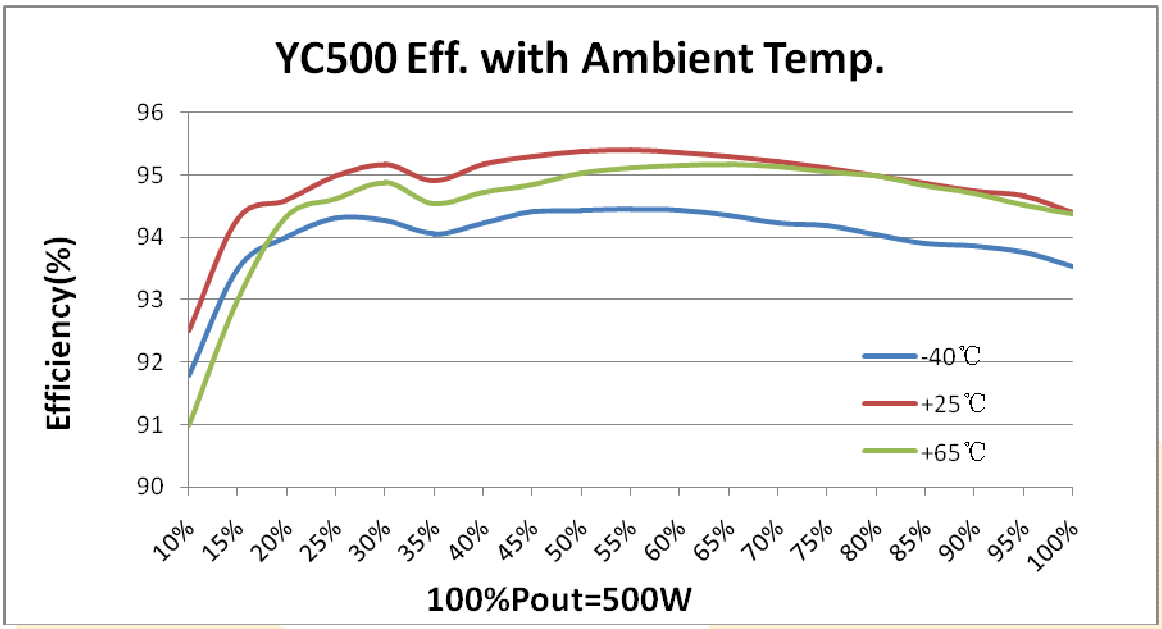
7. Replace a micro-inverter

Follow the procedure to replace a failed APS micro-inverter.

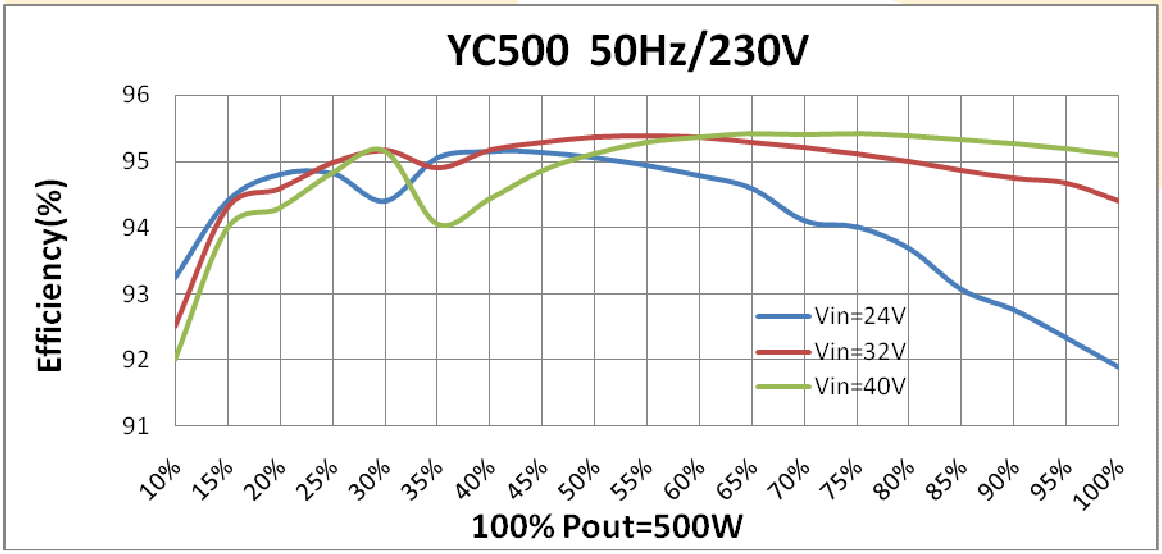
1. Disconnecting the APS micro-inverter from the PV Module, in the order shown below:
   1) Disconnect the AC by opening the branch circuit breaker.
   2) Cover the module with an opaque cover.
   3) Disconnect the first AC connector in the branch circuit.
   4) Disconnect the PV module DC wire connectors from the micro-inverter.
   5) Remove the micro-inverter from the PV array racking.
2. Install a replacement micro-inverter to the rack.
3. Connect the AC cable of the replacement micro-inverter and the neighboring micro-inverters to complete the branch circuit connections.
4. Close the branch circuit breaker, and verify operation of the replacement micro-inverter.

8. Efficiency Curves

YC500 Efficiency-temperature Curves



YC500 Efficiency Curves



9. Technical Data

WARNING: Be sure to verify the voltage and current specifications of your PV module match with those of the micro-inverter. Refer to the APS website http://www.altenergy-power.com for a list of approved PV modules.

WARNING: You must match the DC operating voltage range of the PV module with the allowable input voltage range of the APS micro-inverter.

WARNING: The maximum open circuit voltage of the PV module must not exceed the specified maximum input voltage of the APS micro-inverter.

YC250A/YC250I Technical Specifications (SAA)

Type	YC250A/YC250I
Input Data (DC)	
Recommended PV Module Power (STC)Range	180-310W
MPPT Voltage Range	22-45VDC
MPPT Voltage Range @ Full Power	26-45VDC
Maximum Input Voltage	55VDC
Startup Voltage	22V
Maximum Input Current	10.5A
Output Data (AC)	
Maximum Continuous Power	250W
Maximum Continuous Current	1.08A
Rated Grid Voltage	230VAC
Default Output Voltage Range	200V-270V[1]
Extended Output Voltage Range	149V-278V
Rated Grid Frequency	50Hz
Default Output Frequency Range	47.5Hz-50.5Hz [1]
Extended Output Frequency Range	45.1Hz -54.9Hz
Power Factor	>0.99
Total Harmonic Distortion	<3%
Maximum Units per Branch	14 for 20A Breaker/18 for 25A Breaker
Efficiency	
Max. Inverter Efficiency	95.5% (With HF Transformer)
Mechanical Data	
Operating Ambient Temperature	-40 °C to +65°C
Operating Internal Temperature	-40 °C to +85°C
Storage Temperature Range	-40 °C to +85°C
Dimensions (W x H x D)	160mmX 150mmX 29mm
Weight	1.5kg
Waterproof Level	IP65
Cooling	Natural Convection
Wet Locations Classification	For Wet Locations
Pollution Degree Classification	PD3
Relative Humidity Ratings	0-95%
Maximum Altitude Rating	All data at this technical Specifications has been tested under <2000m
Overvoltage Category	OVC II for PV input circuit, OVC III for mains circuit
Features & Compliance	
Communication	Power Line
Design Lifetime	25yrs
Grid Connection Compliance	AS 4777.2/AS 4777.3
Safety Class Compliance	EN 62109-1; EN 62109-2;AS3100
[1]Programmable through ECU to meet customer need.	

The specifications are subject to change without notice.

YC500A/YC500I Technical Specifications (SAA)

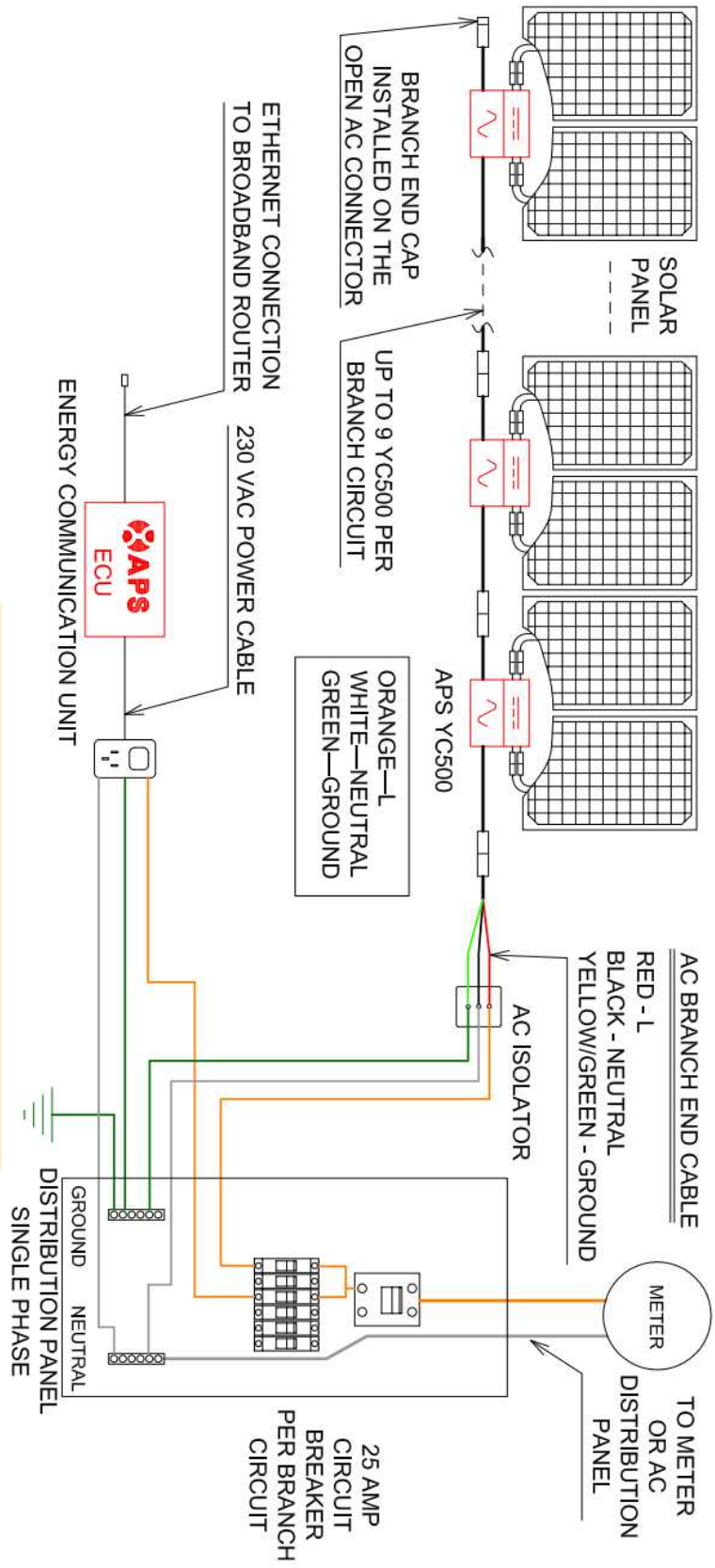
Type	YC500A/YC500I(for 2 panels)
Input Data (DC)	
Recommended PV module power (STC) range	180-310W
MPPT voltage range	22-45VDC
MPPT Voltage Range @ Full Power	26-45VDC
Maximum Input Voltage	55VDC
Startup Voltage	22V
Maximum Input Current	10.5AX2
Output Data (AC)	
Maximum Continuous Power	500W
Maximum Continuous Current	2.17A
Rated Grid Voltage	230VAC
Default Output Voltage Range	200V-270V[1]
Extended Output Voltage Range	149V-278V
Rated Grid Frequency	50Hz
Default Output Frequency Range	47.5Hz-50.5Hz[1]
Extended Output Frequency Range	45.1Hz -54.9Hz
Power Factor	>0.99
Total Harmonic Distortion	<3%
Maximum Units per Branch	7 for 20A Breaker/9 for 25A Breaker
Efficiency	
Max. Inverter Efficiency	95.5% (with HF Transformer)
Mechanical Data	
Operating Ambient Temperature	-40°C to +65°C
Operating Internal Temperature	-40ºC to +85ºC
Storage Temperature Range	-40ºC to +85ºC
Dimensions (W x H x D)	221mm X 167mm X 29mm
Weight	2.5kg
Waterproof Level	IP65
Cooling	Natural Convection
Wet Locations Classification	For Wet Locations
Pollution Degree Classification	PD3
Relative Humidity Ratings	0-95%
Maximum Altitude Rating	All data at this technical Specifications has been tested under <2000m
Overvoltage Category	OVC II for PV input circuit, OVC III for mains circuit
Features & Compliance	
Communication	Power Line
Design Lifetime	25yrs
Grid Connection Compliance	AS 4777.2/AS 4777.3
Safety Class Compliance	EN 62109-1; EN 62109-2;AS3100

[1] Programmable through ECU to meet customer need.

The specifications are subject to change without notice.

10. Wiring Diagram

10.1 Sample Wiring Diagram – Single Phase



10.2 Sample Wiring Diagram – Three Phase